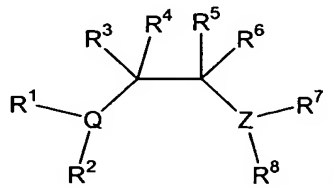
CLAIMS

What is claimed is:

1. A Group 3 through 11 (IUPAC) transition metal or lanthanide metal complex of a ligand of the formula (I)



(I)

wherein:

Z is nitrogen or oxygen; and

Q is nitrogen or phosphorous;

provided that:

when Q is phosphorous and Z is nitrogen: R^1 and R^2 are each independently hydrocarbyl, silyl, or substituted hydrocarbyl having an E_s of about –0.90 or less; R^3, R^4, R^5, and R^6 are each independently hydrogen, hydrocarbyl, a functional group, or substituted hydrocarbyl; R^7 is hydrogen, hydrocarbyl, substituted hydrocarbyl or silyl; and R^8 is hydrocarbyl, substituted hydrocarbyl, or silyl; provided that any two of R^3, R^4, R^5, R^6, R^7 and R^8 vicinal or geminal to one another together may form a ring;

when Q is phosphorous and Z is oxygen:

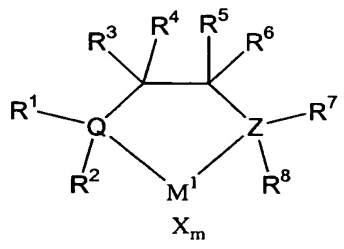
R^1 and R^2 are each independently hydrocarbyl, silyl, or substituted hydrocarbyl having an E_s of about –0.90 or less; R^3 and R^4 are each independently hydrogen, hydrocarbyl, a functional group, or substituted hydrocarbyl; R^5 and R^7 taken together form a double bond; R^8 is not present; and R^6 is $-OR^9$, $-NR^{10}R^{11}$, hydrocarbyl or substituted hydrocarbyl, wherein R^9 is hydrocarbyl or substituted hydrocarbyl, and R^{10} and R^{11} are each independently hydrogen, hydrocarbyl or substituted hydrocarbyl; and provided that any two of R^3, R^4, and R^6 vicinal or geminal to one another may form a ring; or

R^1 and R^2 are each independently hydrocarbyl, silyl, or substituted hydrocarbyl having an E_s of about –0.90 or less; R^3, R^4, R^5 and R^6 are each independently hydrogen, hydrocarbyl, a functional group, or substituted hydrocarbyl; R^7 is hydrocarbyl, silyl, or substituted hydrocarbyl; and R^8 is not present; and provided that any two of R^3, R^4, R^5, R^6, and R^7 vicinal or geminal to one another may form a ring;

when Q is nitrogen: R^1 is hydrocarbyl, silyl, or substituted hydrocarbyl having an E_S of about –0.90 or less; R^2 and R^3 are each independently hydrogen, hydrocarbyl, a functional group, or substituted hydrocarbyl, or taken together form a double bond; R^4 is hydrogen, hydrocarbyl, a functional group, or substituted hydrocarbyl; Z is oxygen; R^6 and R^7 taken together form a double bond; R^8 is not present; R^5 is -OR^{12}, -R^{13} or -$NR^{14}R^{15}$, wherein R^{12} and R^{13} are each independently hydrocarbyl or substituted hydrocarbyl, and R^{14} and R^{15} are each hydrogen, hydrocarbyl or substituted hydrocarbyl; provided that when R^2 and R^3 taken together form an aromatic ring, R^1 and R^4 are not present; and further provided that any two of R^2, R^3, R^4 and R^5 vicinal or germinal to one another taken together may form a ring.

2. The transition metal complex of Claim 1, wherein the transition metal is selected from Ni, Fe, Ti and Zr.

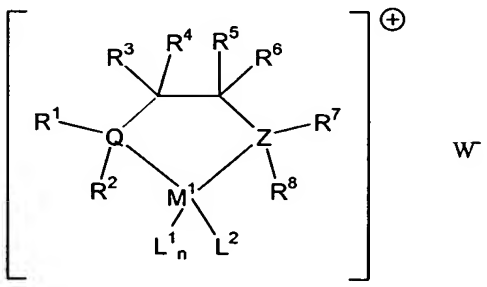
3. The transition metal complex of Claim 1, having the formula (IV)



(IV)

wherein M^1 is the transition metal; each X is independently a monoanion; and m is an integer equal to an oxidation state of M^1.

4. The transition metal complex of Claim 1, having the formula (IX)



(IX)

wherein M^1 is the transition metal; L^1 is a monoanionic ligand which may add to an olefin; n is equal to the oxidation state of M^1 minus one; L^2 is a ligand which may be displaced by an olefin or is an empty coordination site; or L^1 and L^2 taken together are a bidentate monoanionic ligand into which an olefin molecule may insert between the ligand and a metal atom; and W is a relatively noncoordinating anion.

5. The transition metal complex of Claim 1, wherein Q is phosphorous and Z is oxygen.

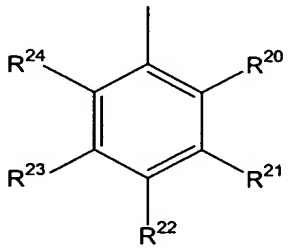
6. The transition metal complex of Claim 5, wherein R^1 and R^2 are t-butyl; R^3 and R^4 are hydrogen; and/or R^6 is $-OR^9$, $-NR^{10}R^{11}$, alkyl, aryl or substituted aryl; and/or R^9 is alkyl or aryl; and/or R^{10} and R^{11} are each independently aryl or substituted aryl.

7. The transition metal complex of Claim 1, wherein Q is phosphorous and Z is nitrogen.

8. The transition metal complex of Claim 7, wherein R^1 and R^2 are t-butyl; and/or R^8 is aryl or substituted aryl; and/or R^3, R^4 and R^5 are hydrogen, hydrocarbyl or substituted hydrocarbyl; and/or R^6 is aryl or substituted aryl; and/or R^7 is benzyl.

9. The transition metal complex of Claim 1, wherein Q is nitrogen and Z is oxygen.

10. The transition metal complex of Claim 9, wherein R^1 is a 2,5-disubstituted pyrrole or a group of the formula (VII)



(VII)

wherein R^{20}, R^{21}, R^{22}, R^{23} and R^{24} are each independently hydrogen, hydrocarbyl substituted hydrocarbyl or a functional group,

provided than any two of R^{20}, R^{21}, R^{22}, R^{23} and R^{24} ortho to another taken together may form a ring; and/or

R^4 is alkyl; and/or

R^5 is $-OR^{12}$, $-R^{13}$ or $-NR^{14}R^{15}$; and/or

R^{12} is alkyl; and/or

R^{13} is alkyl; and/or

R^{14} is alkyl containing 1 to 6 carbon atoms; and/or

R^{15} is hydrogen or alkyl; and/or

R^{15} and R^4 taken together form a ring; and/or

R^4 and R^{12} taken together form a ring; and/or

R^4 and R^{13} taken together form a ring.

11. A process for the polymerization of olefins, comprising the step of contacting, under polymerizing conditions, one or more polymerizable olefins with an active polymerization catalyst comprising a transition metal complex as set forth above in Claim 1.

12. The process of Claim 11, wherein said one or more polymerizable olefins are compounds of the formula $H_2C=CH(CH_2)_nG$ (VIII), wherein n is 0 or an integer of 1 or more, g is hydrogen or $-CO_2R^{25}$, and R^{25} is hydrogen, hydrocarbyl or substituted hydrocarbyl.

13. The process of Claim 12, wherein said one or more polymerizable olefins comprises ethylene.

14. The process of Claim 13, wherein said one or more polymerizable olefins comprises ethylene and at least one other polymerizable olefin.

15. A process for the manufacture of a polar copolymer by contacting, under polymerizing conditions, a hydrocarbon olefin, a polar olefin, and a polymerization catalyst comprising a nickel complex of a bidentate ligand which is an active ligand.

16. The process of Claim 15, provided that when CO is present, at least one other polar olefin is also present.

17. The process of Claim 15 wherein said active ligand meets the condition for Test 2, as defined herein.

18. The process of Claim 15, wherein said hydrocarbon olefin is one or more of ethylene and $H_2C=CHR^{26}$ wherein R^{26} is n-alkyl, and said polar olefin is one or more of $H_2C=CHR^{27}CO_2R^{28}$ wherein R^{27} is n-alkylene or a covalent bond and R^{28} is hydrocarbyl or substituted hydrocarbyl.

19. The process of Claim 18, wherein said hydrocarbon olefin is ethylene.

20. The process of Claim 15, wherein said process is carried out at about 50°C to about 170°C.

21. The process of Claim 18, wherein a pressure of said ethylene is at least about 700 kPa and said process is carried out at a temperature of about 50°C to about 170°C.

22. An improved process for the manufacture of a polar copolymer by contacting, under polymerizing conditions, a hydrocarbon olefin, a polar olefin, and a polymerization catalyst comprising a nickelcomplex, wherein the improvement comprises that the polymerization catalyst comprises a nickel complex of a bidentate ligand which is an active ligand.

23. The process of Claim 22 wherein said active ligand meets the condition for Test 2, as defined herein.

24. The process of Claim 22 wherein said process is carried out at about 50°C to about 170°C.

25. The process of Claim 24 wherein said hydrocarbon olefin is one or more of ethylene and $H_2C=CHR^{26}$ wherein R^{26} is n-alkyl, and said polar olefin is one or more of $H_2C=CHR^{27}CO_2R^{28}$ wherein R^{27} is n-alkylene or a covalent bond and R^{28} is hydrocarbyl or substituted hydrocarbyl.

26. The transition metal complex of Claim 5, wherein R^1 and R^2 are t-butyl, and/or R^3, R^4, R^5, and R^6 are hydrogen; and/or R^7 is aryl or substituted aryl.